

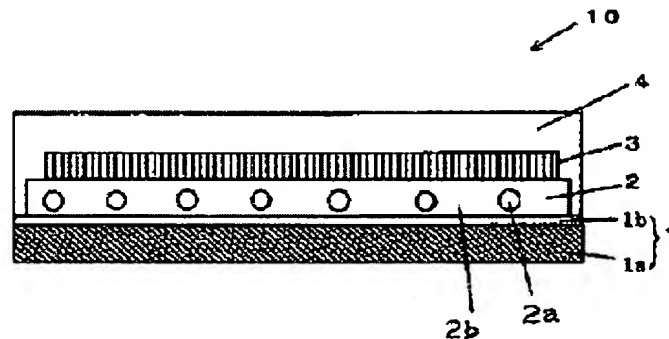
ELECTRIC FIELD LUMINESCENT LIGHT**Publication number:** JP2001319786**Publication date:** 2001-11-16**Inventor:** MORI NAOYUKI**Applicant:** KANSAI NIPPON ELECTRIC**Classification:****- International:** C09K11/08; H05B33/14; H05B33/26; C09K11/54; C09K11/08; H05B33/14; H05B33/26; C09K11/54; (IPC1-7): C09K11/54; H05B33/14; C09K11/08; H05B33/26**- european:****Application number:** JP20000138575 20000511**Priority number(s):** JP20000138575 20000511

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Abstract of JP2001319786

PROBLEM TO BE SOLVED: To provide an inexpensive electric field luminescent light of high luminance and high insulation voltage in which a reflection insulating layer is unnecessary.

SOLUTION: On a transparent electrode 1b of the ITO or the like which has been formed on a transparent film 1a, a luminous layer 2 where a phosphor formed by activating zinc sulfide by copper is dispersed in a resin. The weight ratio of phosphor to the resin is 2.5 to 4.5, and the film thickness of luminous layer is 40 to 50 μ m. On the luminous layer 2, a rear face electrode 3 consisting of metal powder, white filler, and resin is printed and formed, and an insulation protective layer 4 is printed and formed to make the electric field luminescent light.



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CLAIMS

[Claim(s)]

[Claim 1] The electroluminescence LGT characterized by for the weight ratios of the fluorescent substance to the resin of said luminous layer being 2.5-4.5, and the thickness of a luminous layer being 40-50 micrometers in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer.

[Claim 2] The electroluminescence LGT according to claim 1 characterized by said rear-face electrode consisting of a metal paste containing more than a kind of silver, nickel, and the aluminum.

[Claim 3] The electroluminescence LGT which the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, and the thickness of a luminous layer is 40-50 micrometers in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, and is characterized by said rear-face electrode consisting of resin, metal powder, and a white insulation filler.

[Claim 4] The electroluminescence LGT according to claim 3 characterized by the weight ratios of the white insulation filler to metal powder being 20-30 in said rear-face electrode.

[Claim 5] The electroluminescence LGT according to claim 3 characterized by for said metal powder consisting more than of a kind of silver, nickel, and the aluminum, and a white insulation filler consisting more than of a kind of titanium oxide, barium titanate, and the zinc oxides.

[Claim 6] The electroluminescence LGT which the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, and the thickness of a luminous layer is 40-50 micrometers in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, and is characterized by said rear-face electrode consisting of resin, metal powder, and a white conductivity filler.

[Claim 7] The electroluminescence LGT according to claim 6 characterized by the weight ratios of the white conductivity filler to metal powder being 16-51 in said rear-face electrode.

[Claim 8] The electroluminescence LGT according to claim 6 characterized by for said metal powder consisting more than of a kind of silver, nickel, and the aluminum, and consisting more than of a kind of the titanium oxide with which a white conductivity filler has conductivity, barium titanate, and the zinc oxides.

[Claim 9] The electroluminescence LGT according to claim 8 with which said white conductivity filler is characterized by consisting more than of a kind of the titanium oxide covered with the conductive tin oxide and/or conductive indium oxide in the front face, barium titanate, and the zinc oxides.

[Claim 10] Said zinc oxide is an electroluminescence LGT according to claim 8 characterized by being the zinc oxide which doped aluminum and was semi-conductor-ized.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the suitable cheap electroluminescence LGT of high brightness especially for the back light of liquid crystal about an electroluminescence LGT.

[0002]

[Description of the Prior Art] Conventional common electroluminescence LGT 20 has the structure which carried out laminating printing of the luminous layer 12 which distributed the fluorescent substance to resin, the reflective insulating layer 13 which distributed barium titanate to resin, the rear-face electrode 14 which consists of carbon paste, and the insulating protective layer 15 which consists of resin one by one on this transparent electrode 11b of the transparence electric conduction film 11 in which transparent electrode 11b was formed on bright film 11a, as shown in the sectional view of drawing 8. This kind of electroluminescence LGT has a thin shape and the description of being lightweight.

[0003]

[Problem(s) to be Solved by the Invention] By the way, in conventional electroluminescence LGT 20, the operation effectiveness of the reflective insulating layer 13 formed in the rear-face side of a luminous layer 12 is improvement in brightness by the inter-electrode improvement in withstand voltage, and improvement in a reflection factor. In order to improve a reflection factor, the powder of the white of barium titanate etc. is used. However, since the electrical potential difference impressed to inter-electrode is distributed also to the reflective insulating layer 13, the electrical potential difference impressed so much to a luminous layer falls, and brightness loss produces it. Moreover, by printing a reflective insulating layer, the count of a laminating increased and there was a problem of becoming cost quantity.

[0004] Then, the purpose of this invention is offering the cheap thin electroluminescence LGT which does not form a reflective insulating layer, but has a reflex function while reducing cost by reducing the count of a laminating, and aimed at improvement in brightness.

[0005]

[Means for Solving the Problem] In the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, and this invention is characterized by the thickness of a luminous layer being 40-50 micrometers. By this configuration, the luminous layer by which the fluorescent substance was laid underground into insulating resin is obtained. Since a fluorescent substance is covered with resin, the insulation of a luminous layer improves, and the electroluminescence LGT with which the three-tiered structure of a transparent electrode, a luminous layer, and a rear-face electrode also has pressure-proofing enough can be realized. For this reason, a reflective insulating layer can be excluded, cost can decrease and a cheap electroluminescence LGT can be offered.

[0006] Moreover, by forming a rear-face electrode with the metal paste which consists more than of a kind of silver, nickel, and the aluminum in addition to said configuration, this invention serves as low resistance from conventional carbon paste, and can offer the electroluminescence LGT of high brightness.

[0007] Moreover, in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, the thickness of a luminous layer is 40-50 micrometers, and this invention is characterized by said rear-face electrode consisting of resin, metal powder, and a white insulation filler. According to this configuration, the resistance of a rear-face electrode falls, and since the rate of a light reflex is high, the brightness at the time of IC inverter drive can be raised, and the cheap electroluminescence LGT of high brightness can be offered.

[0008] Moreover, the electroluminescence LGT of this invention is characterized by the weight ratios of the white insulation filler to the metal powder in a rear-face electrode being 20-30. According to this configuration, the balance of the rate of a light reflex of a rear-face electrode and resistance loss becomes the optimal, and can offer the cheap electroluminescence LGT of high brightness.

[0009] Moreover, the electroluminescence LGT of this invention is characterized by for the metal powder of a rear-face electrode consisting more than of a kind of silver, nickel, and the aluminum, and a white insulation filler consisting more than of a kind of titanium oxide, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0010] Moreover, in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, the thickness of a luminous layer is 40-50 micrometers, and this invention is characterized by said rear-face electrode consisting of resin, metal powder, and a white conductivity filler. Since the resistance of a rear-face electrode falls rather than the case where a white insulation filler is used according to this configuration, the resistance loss at the time of IC inverter drive can decrease, and brightness can be raised further.

[0011] Moreover, the electroluminescence LGT of this invention is characterized by the weight ratios of the white conductivity filler to the metal powder in a rear-face electrode being 16-51. By this configuration, the balance of the rate of a light reflex of a rear-face

electrode and resistance loss becomes the optimal, and can offer the cheap electroluminescence LGT of high brightness.

[0012] Moreover, it is characterized by for the metal powder in a rear-face electrode consisting more than of a kind of silver, nickel, and the aluminum, and the electroluminescence LGT of this invention consisting more than of a kind of the titanium oxide with which a white conductivity filler has conductivity, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0013] Moreover, it is characterized by a white conductivity filler [in / in the electroluminescence LGT of this invention / a rear-face electrode] consisting more than of a kind of the titanium oxide covered with the conductive tin oxide and/or conductive indium oxide in the front face, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0014] Moreover, it is characterized by being the zinc oxide with which the zinc oxide in a rear-face electrode doped aluminum, and the electroluminescence LGT of this invention was semi-conductor-ized. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0015]

[Embodiment of the Invention] It explains referring to drawing about the gestalt of operation of the 1st of the electroluminescence LGT of this invention. Electroluminescence LGT 10 of the gestalt of the 1st operation is having structure shown in the sectional view of drawing 1 . This electroluminescence LGT 10 is manufactured as follows. First, on bright film 1a, fluorescent substance 2a which activated zinc sulfide with copper is screen-stenciled using the ink distributed to resin 2b for binders (for example, polyester system resin) on this transparent electrode 1b of the transparence electric conduction film 1 which vapor-deposited transparent electrode 1b, such as ITO, and a luminous layer 2 is formed. Printing formation of the rear-face electrode 3 which consists of carbon paste etc. on it is carried out. Printing formation of the insulating protective layers 4, such as epoxy system resin and phenol system resin, is carried out on it, and electroluminescence LGT 10 is obtained.

[0016] The description of the electroluminescence LGT of this invention is that fluorescent substance 2a is certainly laid underground into insulating resin 2b in a luminous layer 2, as shown in drawing 2 . Since fluorescent substance 2a is covered with resin 2b, its insulation is high. For this reason, a reflective insulating layer can be excluded. Even if it forms the direct rear-face electrode 3 on a luminous layer 2, withstand voltage does not run short. In order to form the luminous layer of the gestalt shown in drawing 2 according to experiment examination of an artificer, it is necessary to make combination of the rate of a fluorescent substance and the thickness of a luminous layer to the resin of a luminous layer into the proper range. That is, the electroluminescence LGT which a fluorescent substance is laid underground into resin, and has sufficient withstand voltage, and secured practical use brightness can be obtained by [of the fluorescent substance to the resin of a luminous layer] being referred to comparatively (weight ratio) as 2.5-4.5, and setting thickness to 40-50 micrometers.

[0017] Next, the experimental result used as the basis of said range is explained in detail with reference to drawing. Drawing 3 shows the rate of a fluorescent substance and the relation of withstand voltage to the resin at the time of making luminous layer thickness into a parameter. Drawing 3 shows that withstand voltage improves, so that the rate of a fluorescent substance is small, and, so that luminous layer thickness becomes large. In addition, withstand voltage is an electrical-potential-difference value when the alternating voltage of 60Hz is impressed to an electroluminescence LGT and dielectric breakdown arises. Since an electroluminescence LGT is usually driven with IC inverter whose output voltage is 40-60V, withstand voltage is required more than 75V.

[0018] Next, drawing 4 shows the rate of a fluorescent substance and the relation of brightness to the resin at the time of making luminous layer thickness into a parameter. Drawing 4 shows the inclination for brightness to become high, so that thickness is small. However, if thickness becomes smaller than 40 micrometers of abbreviation, and a fluorescent substance rate increases, brightness will decrease rapidly. Two or more 2 cd/m is required as practical use brightness. In addition, input voltage 3.5V estimated brightness using IC inverter (inverter which connected the 150pF capacitor and the coil of 10mH to IC 4422made from SAIPEKKUSU A).

[0019] As mentioned above, in order to obtain the electroluminescence LGT which are more than withstand voltage 75V and two or more brightness 2 cd/m, and was able to balance withstand voltage and brightness putting together the result shown in drawing 3 and drawing 4 , it is desirable to set the rate of a fluorescent substance to resin to 2.5-4.5, and to set luminous layer thickness to 40-50 micrometers.

[0020] In addition, with the gestalt of the 1st operation, although polyester system resin was used as a binder of a luminous layer, if resin, such as a phenol system of a heat-curing mold, a melamine system, an epoxy system, and a polyester system, is used, there is effectiveness which can control that the solvent of the paste for rear-face electrodes invades into a luminous layer at the time of rear-face electrode formation. Moreover, it is effective even if it uses what does not dissolve the resin of a luminous layer in the solvent of the paste for rear-face electrodes.

[0021] Next, the gestalt of operation of the 2nd of the electroluminescence LGT of this invention is explained. The description is that improved the ingredient of the rear-face electrode of the electroluminescence LGT of the gestalt of the 1st operation, and it improved brightness sharply. With the electroluminescence LGT of the gestalt of the 1st operation, since black carbon paste is used for the rear-face electrode, luminescence of a fluorescent substance is absorbed and brightness becomes low. Moreover, there is also resistance loss by carbon paste. The paste which mixed in resin metal impalpable powder with the high reflection factor which replaces with carbon paste and has metallic luster (for example, silver dust, aluminium powder, nickel powder, etc.) is used for the rear-face electrode of the gestalt of the 2nd operation. Conductivity is secured with metal impalpable powder. conductivity is boiled markedly and is superior to carbon, the tin oxide, indium oxide, etc. According to this structure, the resistance and reflection factor of a rear-face electrode are improved sharply, and brightness can be raised.

[0022] Drawing 5 is the rate of a fluorescent substance and the relation of brightness to the resin at the time of making a rear-face electrode material into a parameter. Luminous layer thickness is 40 micrometers. Since it is high and conductivity becomes [surface electrical resistance] small while a reflection factor improves by using a silver paste for a rear-face electrode, compared with carbon, brightness improves more than twice. The same result is obtained also when the paste which mixed aluminium powder, nickel powder, etc. in resin other than the silver paste is used.

[0023] Next, the gestalt of operation of the 3rd of the electroluminescence LGT of this invention is explained. Rather than the gestalt of the 2nd operation, the gestalt of the 3rd operation raises a reflection factor further, and improves brightness. Although the structure of an electroluminescence LGT be the same configuration as the gestalt of the 1st operation , printing formation be carry out using the paste which mixed the white insulation filler (for example , impalpable powder , such as titanium oxide , barium titanate , and a zinc

oxide Y' with metal powder with the high reflection factor which have the description in the presentation of a rear face electrode, and have metallic luster (for example, silver dust, aluminium powder, nickel powder, etc.) in resin. A reflection factor is further improved by this configuration, and brightness improves. Drawing 6 is an example and is the relation of the rate of titanium oxide powder and brightness (at the time of IC inverter drive) to the silver dust of a rear-face electrode. By carrying out optimum dose addition of the white insulation fillers, such as titanium oxide powder, at a silver paste, as shown in drawing 6, a reflection factor improves and brightness improves. 20-30 (weight ratio) carry out suitable [of the rate of titanium oxide powder to silver dust]. If a white insulation filler is added in large quantities, the resistance of a rear-face electrode will increase, resistance loss increases, and the output voltage of IC inverter does not go up, but brightness falls rapidly. The same result is obtained, even if it replaces with titanium oxide and uses barium titanate and a zinc oxide.

[0024] Next, the gestalt of operation of the 4th of the electroluminescence LGT of this invention is explained. Rather than the gestalt of the 3rd operation, the 4th operation gestalt improves conductivity and improves brightness further. Although the structure of an electroluminescence LGT is the same configuration as the gestalt of the 1st operation, the description uses for the rear-face electrode the paste which mixed with silver dust in resin the white conductivity filler (for example, impalpable powder, such as titanium oxide which gave conductivity, barium titanate, and a zinc oxide). Since a white filler has conductivity according to this structure and the resistance loss of a rear-face electrode decreases further, the effectiveness of IC inverter improves and brightness improves. Drawing 7 is an example and is the relation of the rate of conductive titanium oxide powder and brightness (at the time of IC inverter drive) to the silver dust of a rear-face electrode. The result at the time of mixing the insulating titanium oxide powder of drawing 6 for a comparison is also shown. Brightness improves further by adding white conductivity fillers, such as conductive titanium oxide powder, to a silver paste, as shown in drawing 7. Since a white filler is conductivity and it is hard to increase resistance, the rate of a white filler can be increased from the 3rd example (drawing 6). In drawing 7, brightness higher than 7.2 cds of the maximum brightness abbreviation for drawing 6 /and m2 is obtained in [large] 16-51 (weight ratio). The maximum brightness is obtained when a rate is abbreviation 40. Since resistance is larger than metal powder even if it is a white conductivity filler, if it adds in large quantities, the resistance of a rear-face electrode will increase, resistance loss increases, and the output voltage of IC inverter does not go up, but brightness falls rapidly.

[0025] As a white conductivity filler, the thing in which transparence conductive layers, such as SnO₂ and In₂O₃, were formed on the front face of white impalpable powder, such as titanium oxide, barium titanate, and a zinc oxide, the thing which doped and semi-conductor-ized minute impurities during the crystal of white impalpable powder carry out suitable. For example, what covered the conductive layer which becomes the front face of the rutile mold TiO₂ with a particle size of 0.03-0.3 micrometers from the Sb dope SnO₂, and the things (Hakusui Tech, Inc., 23-K, etc.) which doped and n-type-semiconductor-ized aluminum+3 during ZnO crystals (Ishihara Sangyo Kaisha, Ltd., ET series, etc.) carry out suitable.

[0026]

[Effect of the Invention] According to this invention, since the fluorescent substance of a luminous layer, the ratio of resin, and luminous layer thickness were optimized, the insulation of a luminous layer improves. For this reason, a reflective insulating layer can be removed and the cheap electroluminescence LGT of the three-tiered structure of a transparent electrode, a luminous layer, and a rear-face electrode can be offered.

[0027] Moreover, the reflection factor of light is high, and since the rear-face electrode was formed using the ingredient with low resistance, the cheap electroluminescence LGT of the three-tiered structure which raised brightness by IC inverter drive can be offered.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the suitable cheap electroluminescence LGT of high brightness especially for the back light of liquid crystal about an electroluminescence LGT.

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PRIOR ART

[Description of the Prior Art] Conventional common electroluminescence LGT 20 has the structure which carried out laminating printing of the luminous layer 12 which distributed the fluorescent substance to resin, the reflective insulating layer 13 which distributed barium titanate to resin, the rear-face electrode 14 which consists of carbon paste, and the insulating protective layer 15 which consists of resin one by one on this transparent electrode 11b of the transparence electric conduction film 11 in which transparent electrode 11b was formed on bright film 11a, as shown in the sectional view of drawing 8 . This kind of electroluminescence LGT has a thin shape and the description of being lightweight.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, since the fluorescent substance of a luminous layer, the ratio of resin, and luminous layer thickness were optimized, the insulation of a luminous layer improves. For this reason, a reflective insulating layer can be removed and the cheap electroluminescence LGT of the three-tiered structure of a transparent electrode, a luminous layer, and a rear-face electrode can be offered.

[0027] Moreover, the reflection factor of light is high, and since the rear-face electrode was formed using the ingredient with low resistance, the cheap electroluminescence LGT of the three-tiered structure which raised brightness by IC inverter drive can be offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, in conventional electroluminescence LGT 20, the operation effectiveness of the reflective insulating layer 13 formed in the rear-face side of a luminous layer 12 is improvement in brightness by the inter-electrode improvement in withstand voltage, and improvement in a reflection factor. In order to improve a reflection factor, the powder of the white of barium titanate etc. is used. However, since the electrical potential difference impressed to inter-electrode is distributed also to the reflective insulating layer 13, the electrical potential difference impressed so much to a luminous layer falls, and brightness loss produces it. Moreover, by printing a reflective insulating layer, the count of a laminating increased and there was a problem of becoming cost quantity.

[0004] Then, the purpose of this invention is offering the cheap thin electroluminescence LGT which does not form a reflective insulating layer, but has a reflex function while reducing cost by reducing the count of a laminating, and aimed at improvement in brightness.

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MEANS

[Means for Solving the Problem] In the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, and this invention is characterized by the thickness of a luminous layer being 40-50 micrometers. By this configuration, the luminous layer by which the fluorescent substance was laid underground into insulating resin is obtained. Since a fluorescent substance is covered with resin, the insulation of a luminous layer improves, and the electroluminescence LGT with which the three-tiered structure of a transparent electrode, a luminous layer, and a rear-face electrode also has pressure-proofing enough can be realized. For this reason, a reflective insulating layer can be excluded, cost can decrease and a cheap electroluminescence LGT can be offered.

[0006] Moreover, by forming a rear-face electrode with the metal paste which consists more than of a kind of silver, nickel, and the aluminum in addition to said configuration, this invention serves as low resistance from conventional carbon paste, and can offer the electroluminescence LGT of high brightness.

[0007] Moreover, in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, the thickness of a luminous layer is 40-50 micrometers, and this invention is characterized by said rear-face electrode consisting of resin, metal powder, and a white insulation filler. According to this configuration, the resistance of a rear-face electrode falls, and since the rate of a light reflex is high, the brightness at the time of IC inverter drive can be raised, and the cheap electroluminescence LGT of high brightness can be offered.

[0008] Moreover, the electroluminescence LGT of this invention is characterized by the weight ratios of the white insulation filler to the metal powder in a rear-face electrode being 20-30. According to this configuration, the balance of the rate of a light reflex of a rear-face electrode and resistance loss becomes the optimal, and can offer the cheap electroluminescence LGT of high brightness.

[0009] Moreover, the electroluminescence LGT of this invention is characterized by for the metal powder of a rear-face electrode consisting more than of a kind of silver, nickel, and the aluminum, and a white insulation filler consisting more than of a kind of titanium oxide, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0010] Moreover, in the electroluminescence LGT with which the luminous layer was formed on the transparent electrode, and the rear-face electrode was formed on this luminous layer, the weight ratios of the fluorescent substance to the resin of said luminous layer are 2.5-4.5, the thickness of a luminous layer is 40-50 micrometers, and this invention is characterized by said rear-face electrode consisting of resin, metal powder, and a white conductivity filler. Since the resistance of a rear-face electrode falls rather than the case where a white insulation filler is used according to this configuration, the resistance loss at the time of IC inverter drive can decrease, and brightness can be raised further.

[0011] Moreover, the electroluminescence LGT of this invention is characterized by the weight ratios of the white conductivity filler to the metal powder in a rear-face electrode being 16-51. By this configuration, the balance of the rate of a light reflex of a rear-face electrode and resistance loss becomes the optimal, and can offer the cheap electroluminescence LGT of high brightness.

[0012] Moreover, it is characterized by for the metal powder in a rear-face electrode consisting more than of a kind of silver, nickel, and the aluminum, and the electroluminescence LGT of this invention consisting more than of a kind of the titanium oxide with which a white conductivity filler has conductivity, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0013] Moreover, it is characterized by a white conductivity filler [in / in the electroluminescence LGT of this invention / a rear-face electrode] consisting more than of a kind of the titanium oxide covered with the conductive tin oxide and/or conductive indium oxide in the front face, barium titanate, and the zinc oxides. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0014] Moreover, it is characterized by being the zinc oxide with which the zinc oxide in a rear-face electrode doped aluminum, and the electroluminescence LGT of this invention was semi-conductor-ized. By this concrete configuration, the cheap electroluminescence LGT of high brightness can be offered easily.

[0015]

[Embodiment of the Invention] It explains referring to drawing about the gestalt of operation of the 1st of the electroluminescence LGT of this invention. Electroluminescence LGT 10 of the gestalt of the 1st operation is having structure shown in the sectional view of drawing 1 . This electroluminescence LGT 10 is manufactured as follows. First, on bright film 1a, fluorescent substance 2a which activated zinc sulfide with copper is screen-stenciled using the ink distributed to resin 2b for binders (for example, polyester system resin) on this transparent electrode 1b of the transparence electric conduction film 1 which vapor-deposited transparent electrode 1b, such as ITO, and a luminous layer 2 is formed. Printing formation of the rear-face electrode 3 which consists of carbon paste etc. on it is carried out. Printing formation of the insulating protective layers 4, such as epoxy system resin and phenol system resin, is carried out on it, and electroluminescence LGT 10 is obtain

[0016] The description of the electroluminescence LGT of this invention is that fluorescent substance 2a is certainly laid underground into insulating resin 2b in a luminous layer 2, as shown in drawing 2 . Since fluorescent substance 2a is covered with resin 2b, its

insulation is high. For this reason, a reflective insulating layer can be excluded. Even if it forms the direct rear-face electrode 3 on a luminous layer 2, withstand voltage does not run short. In order to form the luminous layer of the gestalt shown in drawing 2 according to experiment examination of an artificer, it is necessary to make combination of the rate of a fluorescent substance and the thickness of a luminous layer to the resin of a luminous layer into the proper range. That is, the electroluminescence LGT which a fluorescent substance is laid underground into resin, and has sufficient withstand voltage, and secured practical use brightness can be obtained by [of the fluorescent substance to the resin of a luminous layer] being referred to comparatively (weight ratio) as 2.5-4.5, and setting thickness to 40-50 micrometers.

[0017] Next, the experimental result used as the basis of said range is explained in detail with reference to drawing. Drawing 3 shows the rate of a fluorescent substance and the relation of withstand voltage to the resin at the time of making luminous layer thickness into a parameter. Drawing 3 shows that withstand voltage improves, so that the rate of a fluorescent substance is small, and, so that luminous layer thickness becomes large. In addition, withstand voltage is an electrical-potential-difference value when the alternating voltage of 60Hz is impressed to an electroluminescence LGT and dielectric breakdown arises. Since an electroluminescence LGT is usually driven with IC inverter whose output voltage is 40-60V, withstand voltage is required more than 75V.

[0018] Next, drawing 4 shows the rate of a fluorescent substance and the relation of brightness to the resin at the time of making luminous layer thickness into a parameter. Drawing 4 shows the inclination for brightness to become high, so that thickness is small. However, if thickness becomes smaller than 40 micrometers of abbreviation, and a fluorescent substance rate increases, brightness will decrease rapidly. Two or more 2 cd/m is required as practical use brightness. In addition, input voltage 3.5V estimated brightness using IC inverter (inverter which connected the 150pF capacitor and the coil of 10mH to IC 4422made from SAIPEKKUSU A).

[0019] As mentioned above, in order to obtain the electroluminescence LGT which are more than withstand voltage 75V and two or more brightness 2 cd/m, and was able to balance withstand voltage and brightness putting together the result shown in drawing 3 and drawing 4, it is desirable to set the rate of a fluorescent substance to resin to 2.5-4.5, and to set luminous layer thickness to 40-50 micrometers.

[0020] In addition, with the gestalt of the 1st operation, although polyester system resin was used as a binder of a luminous layer, if resin, such as a phenol system of a heat-curing mold, a melamine system, an epoxy system, and a polyester system, is used, there is effectiveness which can control that the solvent of the paste for rear-face electrodes invades into a luminous layer at the time of rear-face electrode formation. Moreover, it is effective even if it uses what does not dissolve the resin of a luminous layer in the solvent of the paste for rear-face electrodes.

[0021] Next, the gestalt of operation of the 2nd of the electroluminescence LGT of this invention is explained. The description is that improved the ingredient of the rear-face electrode of the electroluminescence LGT of the gestalt of the 1st operation, and it improved brightness sharply. With the electroluminescence LGT of the gestalt of the 1st operation, since black carbon paste is used for the rear-face electrode, luminescence of a fluorescent substance is absorbed and brightness becomes low. Moreover, there is also resistance loss by carbon paste. The paste which mixed in resin metal impalpable powder with the high reflection factor which replaces with carbon paste and has metallic luster (for example, silver dust, aluminium powder, nickel powder, etc.) is used for the rear-face electrode of the gestalt of the 2nd operation. Conductivity is secured with metal impalpable powder. conductivity is boiled markedly and is superior to carbon, the tin oxide, indium oxide, etc. According to this structure, the resistance and reflection factor of a rear-face electrode are improved sharply, and brightness can be raised.

[0022] Drawing 5 is the rate of a fluorescent substance and the relation of brightness to the resin at the time of making a rear-face electrode material into a parameter. Luminous layer thickness is 40 micrometers. Since it is high and conductivity becomes [surface electrical resistance] small while a reflection factor improves by using a silver paste for a rear-face electrode, compared with carbon, brightness improves more than twice. The same result is obtained also when the paste which mixed aluminium powder, nickel powder, etc. in resin other than the silver paste is used.

[0023] Next, the gestalt of operation of the 3rd of the electroluminescence LGT of this invention is explained. Rather than the gestalt of the 2nd operation, the gestalt of the 3rd operation raises a reflection factor further, and improves brightness. Although the structure of an electroluminescence LGT be the same configuration as the gestalt of the 1st operation, printing formation be carry out using the paste which mixed the white insulation filler (for example, impalpable powder, such as titanium oxide, barium titanate, and a zinc oxide) with metal powder with the high reflection factor which have the description in the presentation of a rear face electrode, and have metallic luster (for example, silver dust, aluminium powder, nickel powder, etc.) in resin. A reflection factor is further improved by this configuration, and brightness improves. Drawing 6 is an example and is the relation of the rate of titanium oxide powder and brightness (at the time of IC inverter drive) to the silver dust of a rear-face electrode. By carrying out optimum dose addition of the white insulation fillers, such as titanium oxide powder, at a silver paste, as shown in drawing 6, a reflection factor improves and brightness improves. 20-30 (weight ratio) carry out suitable [of the rate of titanium oxide powder to silver dust]. If a white insulation filler is added in large quantities, the resistance of a rear-face electrode will increase, resistance loss increases, and the output voltage of IC inverter does not go up, but brightness falls rapidly. The same result is obtained, even if it replaces with titanium oxide and uses barium titanate and a zinc oxide.

[0024] Next, the gestalt of operation of the 4th of the electroluminescence LGT of this invention is explained. Rather than the gestalt of the 3rd operation, the 4th operation gestalt improves conductivity and improves brightness further. Although the structure of an electroluminescence LGT is the same configuration as the gestalt of the 1st operation, the description uses for the rear-face electrode the paste which mixed with silver dust in resin the white conductivity filler (for example, impalpable powder, such as titanium oxide which gave conductivity, barium titanate, and a zinc oxide). Since a white filler has conductivity according to this structure and the resistance loss of a rear-face electrode decreases further, the effectiveness of IC inverter improves and brightness improves. Drawing 7 is an example and is the relation of the rate of conductive titanium oxide powder and brightness (at the time of IC inverter drive) to the silver dust of a rear-face electrode. The result at the time of mixing the insulating titanium oxide powder of drawing 6 for a comparison is also shown. Brightness improves further by adding white conductivity fillers, such as conductive titanium oxide powder, to a silver paste, as shown in drawing 7. Since a white filler is conductivity and it is hard to increase resistance, the rate of a white filler can be increased from the 3rd example (drawing 6). In drawing 7, brightness higher than 7.2 cds of the maximum brightness abbreviation for drawing 6 /and m2 is obtained in [large] 16-51 (weight ratio). The maximum brightness is obtained when a rate is abbreviation 40. Since resistance is larger than metal powder even if it is a white conductivity filler, if it adds in large quantities, the resistance of a rear-face electrode will increase, resistance loss increases, and the output voltage of IC inverter does not go up, but

brightness falls rapidly.

[0025] As a white conductivity filler, the thing in which transparence conductive layers, such as SnO₂ and In₂O₃, were formed on the front face of white impalpable powder, such as titanium oxide, barium titanate, and a zinc oxide, the thing which doped and semiconductor-ized minute impurities during the crystal of white impalpable powder carry out suitable. For example, what covered the conductive layer which becomes the front face of the rutile mold TiO₂ with a particle size of 0.03-0.3 micrometers from the Sb dope SnO₂, and the things (Hakusui Tech, Inc., 23-K, etc.) which doped and n-type-semiconductor-ized aluminum⁺³ during ZnO crystals (Ishihara Sangyo Kaisha, Ltd., ET series, etc.) carry out suitable.

[Translation done.]

* NOTICES * *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view of the electroluminescence LGT of the gestalt of operation of the 1st of this invention

[Drawing 2] The important section expanded sectional view of the luminous layer in the electroluminescence LGT of the gestalt of operation of the 1st of this invention

[Drawing 3] Drawing showing the rate of a fluorescent substance and the relation of withstand voltage to the resin at the time of making luminous layer thickness into a parameter in the electroluminescence LGT of the gestalt of operation of the 1st of this invention

[Drawing 4] Drawing showing the rate of a fluorescent substance and the relation of brightness to the resin at the time of making luminous layer thickness into a parameter in the electroluminescence LGT of the gestalt of operation of the 1st of this invention

[Drawing 5] Drawing showing the rate of a fluorescent substance and the relation of brightness to the resin at the time of making a rear-face electrode material into a parameter in the electroluminescence LGT of the gestalt of operation of the 2nd of this invention

[Drawing 6] Drawing showing the rate of titanium oxide and the relation of brightness to the silver dust of a rear-face electrode in the electroluminescence LGT of the gestalt of operation of the 3rd of this invention

[Drawing 7] Drawing showing the rate of conductive titanium oxide and the relation of brightness to the silver dust of a rear-face electrode in the electroluminescence LGT of the gestalt of operation of the 4th of this invention

[Drawing 8] The sectional view of the conventional electroluminescence LGT

[Description of Notations]

1 Transparence Electric Conduction Film

1a Bright film

1b Transparent electrode

2 Luminous Layer

2a Fluorescent substance

2b Resin (binder)

3 Rear-Face Electrode

4 Insulating Protective Layer

10 Electroluminescence LGT

[Translation done.]

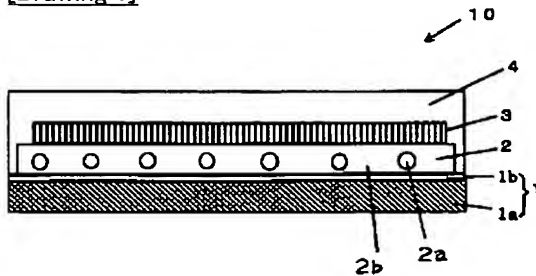
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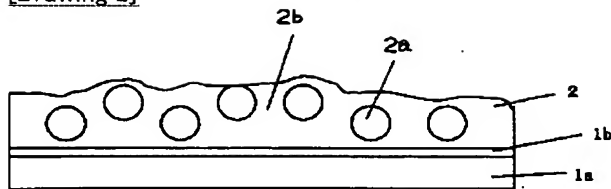
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DRAWINGS

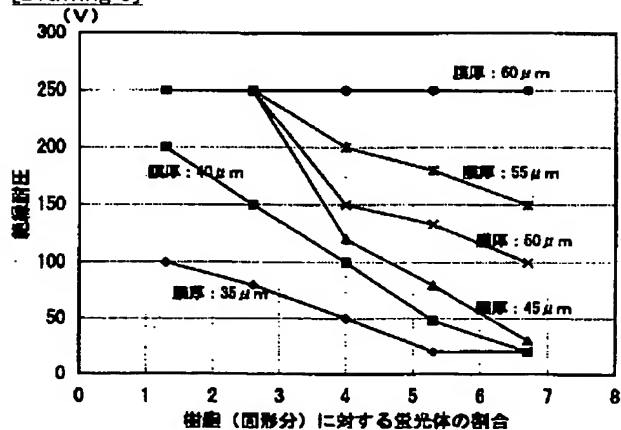
[Drawing 1]



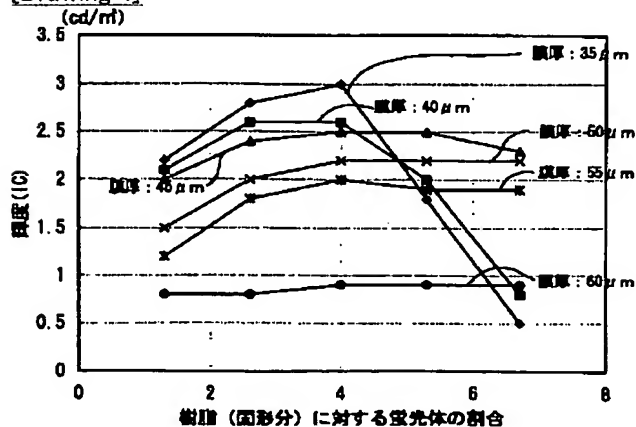
[Drawing 2]



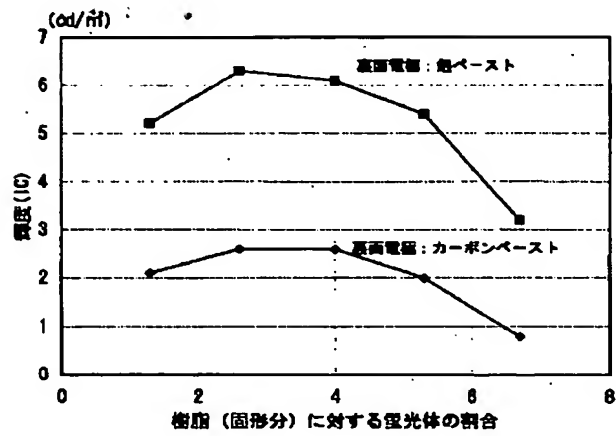
[Drawing 3]



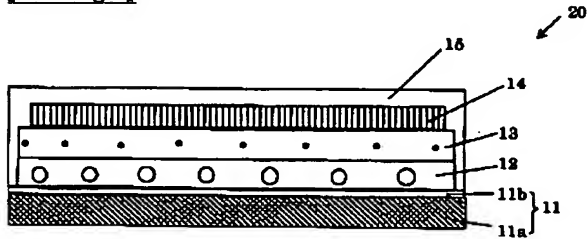
[Drawing 4]



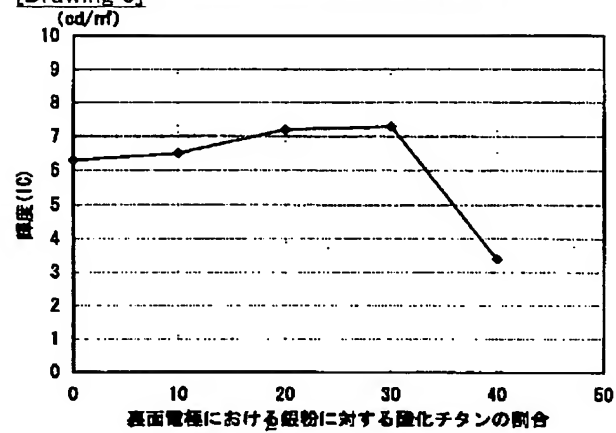
[Drawing 5]



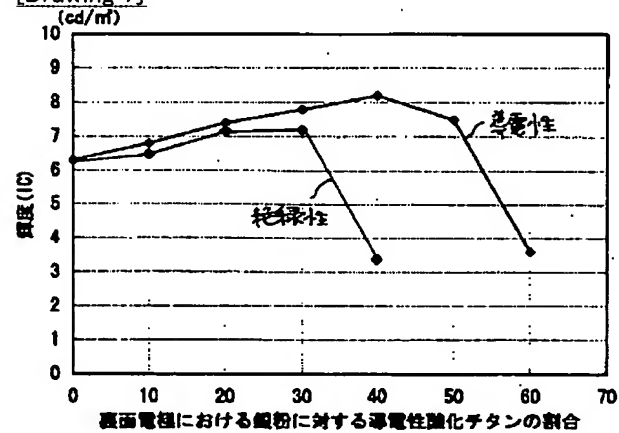
[Drawing 8]



[Drawing 6]



[Drawing 7]



[Translation done.]

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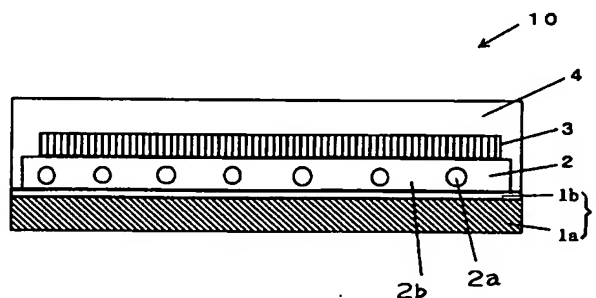
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YA29

(54) 【発明の名称】 電界発光灯

(57) 【要約】

【課題】 反射絶縁層を不要とした高輝度、高絶縁耐圧の安価な電界発光灯を提供する。

【解決手段】 透明フィルム1a上に形成したITO等の透明電極1bの上に、硫化亜鉛を銅で付活した蛍光体を樹脂に分散した発光層2を形成する。樹脂に対する蛍光体の重量比率は2.5～4.5であり、発光層膜厚は40～50 μ mである。発光層2の上に金属粉末、白色フィラー、樹脂からなる裏面電極3を印刷形成し、その上に絶縁保護層4を印刷形成し、電界発光灯10とする。



【特許請求の範囲】

【請求項1】透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであることを特徴とする電界発光灯。

【請求項2】前記裏面電極が銀、ニッケル及びアルミニウムのうち一種以上を含む金属ペーストからなることを特徴とする請求項1に記載の電界発光灯。

【請求項3】透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであり、前記裏面電極が樹脂と、金属粉末と、白色絶縁性フィラーとからなることを特徴とする電界発光灯。

【請求項4】前記裏面電極において、金属粉末に対する白色絶縁性フィラーの重量比率が20～30であることを特徴とする請求項3に記載の電界発光灯。

【請求項5】前記金属粉末が銀、ニッケル及びアルミニウムのうち一種以上からなり、白色絶縁性フィラーが酸化チタン、チタン酸バリウム及び酸化亜鉛のうち一種以上からなることを特徴とする請求項3に記載の電界発光灯。

【請求項6】透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであり、前記裏面電極が樹脂と、金属粉末と、白色導電性フィラーとからなることを特徴とする電界発光灯。

【請求項7】前記裏面電極において、金属粉末に対する白色導電性フィラーの重量比率が16～51であることを特徴とする請求項6に記載の電界発光灯。

【請求項8】前記金属粉末が銀、ニッケル及びアルミニウムのうち一種以上からなり、白色導電性フィラーが導電性を有する酸化チタン、チタン酸バリウム及び酸化亜鉛のうち一種以上からなることを特徴とする請求項6に記載の電界発光灯。

【請求項9】前記白色導電性フィラーが、表面を導電性酸化スズ及び／又は導電性酸化インジウムで被覆された酸化チタン、チタン酸バリウム、酸化亜鉛のうち一種以上からなることを特徴とする請求項8に記載の電界発光灯。

【請求項10】前記酸化亜鉛は、アルミニウムをドーピングして半導体化された酸化亜鉛であることを特徴とする請求項8に記載の電界発光灯。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は電界発光灯に関し、特に液晶のバックライトに好適な安価で高輝度の電界発光灯に関するものである。

【0002】

【従来の技術】従来の一般的な電界発光灯20は、図8の断面図に示すように、透明フィルム11a上に透明電極11bを形成した透明導電フィルム11の該透明電極11b上に、蛍光体を樹脂に分散した発光層12、チタン酸バリウムを樹脂に分散した反射絶縁層13、カーボンペーストからなる裏面電極14、樹脂からなる絶縁保護層15を順次積層印刷した構造を有している。この種の電界発光灯は薄型、軽量という特徴がある。

【0003】

【発明が解決しようとする課題】ところで、従来の電界発光灯20において、発光層12の裏面側に形成された反射絶縁層13の作用効果は、電極間の絶縁耐圧向上と反射率の向上による輝度向上である。反射率を向上するためにチタン酸バリウム等の白色の粉末を使用している。しかしながら、電極間に印加された電圧は反射絶縁層13にも分配されるので、それだけ発光層に印加される電圧が低下して輝度損失が生じる。また、反射絶縁層を印刷することによって、積層回数がふえ、コスト高になるという問題があった。

【0004】そこで、本発明の目的は、反射絶縁層を形成せず、積層回数を減らすことによりコストを低減すると共に、反射機能を有し輝度向上を図った安価で薄型の電界発光灯を提供することである。

【0005】

【課題を解決するための手段】本発明は、透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであることを特徴とする。この構成により、蛍光体が絶縁性の樹脂中に埋設された発光層が得られる。蛍光体が樹脂で被覆されるので発光層の絶縁性が向上し、透明電極、発光層、裏面電極の3層構造でも十分耐圧を有する電界発光灯を実現できる。このため、反射絶縁層を省くことができ、コストが低減して安価な電界発光灯を提供することができる。

【0006】また、本発明は、前記構成に加えて裏面電極を銀、ニッケル及びアルミニウムのうち一種以上からなる金属ペーストで形成することにより、従来のカーボンペーストよりも低抵抗となり高輝度の電界発光灯を提供できる。

【0007】また、本発明は、透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであり、前記裏面電極が樹脂と、金属粉末と、白色絶縁性フィラーとからなることを特徴とする。この構成によると、裏面電極の抵抗値が低下し、かつ、光反射率が高いため、ICインバータ駆動時の輝度を向上させることができ、安価で高輝度の電界発光灯を提供できる。

【0008】また、本発明の電界発光灯は、裏面電極における金属粉末に対する白色絶縁性フィラーの重量比率が20～30であることを特徴とする。この構成によると、裏面電極の光反射率と抵抗損失とのバランスが最適となり、安価で高輝度の電界発光灯を提供できる。

【0009】また、本発明の電界発光灯は、裏面電極の金属粉末が銀、ニッケル及びアルミニウムのうち一種以上からなり、白色絶縁性フィラーが酸化チタン、チタン酸バリウム及び酸化亜鉛のうち一種以上からなることを特徴とする。この具体的な構成により、安価で高輝度の電界発光灯を容易に提供できる。

【0010】また、本発明は、透明電極上に発光層が形成され、該発光層上に裏面電極が形成された電界発光灯において、前記発光層の樹脂に対する蛍光体の重量比率が2.5～4.5であり、発光層の膜厚が40～50 μ mであり、前記裏面電極が樹脂と、金属粉末と、白色導電性フィラーとからなることを特徴とする。この構成によると、白色絶縁性フィラーを用いた場合よりも裏面電極の抵抗値が低下するので、ICインバータ駆動時の抵抗損失が減りさらに輝度を向上させることができる。

【0011】また、本発明の電界発光灯は、裏面電極における金属粉末に対する白色導電性フィラーの重量比率が16～51であることを特徴とする。この構成により、裏面電極の光反射率と抵抗損失とのバランスが最適となり、安価で高輝度の電界発光灯を提供できる。

【0012】また、本発明の電界発光灯は、裏面電極における金属粉末が銀、ニッケル及びアルミニウムのうち一種以上からなり、白色導電性フィラーが導電性を有する酸化チタン、チタン酸バリウム及び酸化亜鉛のうち一種以上からなることを特徴とする。この具体的な構成により、安価で高輝度の電界発光灯を容易に提供できる。

【0013】また、本発明の電界発光灯は、裏面電極における白色導電性フィラーが、表面を導電性酸化スズ及び／又は導電性酸化インジウムで被覆された酸化チタン、チタン酸バリウム、酸化亜鉛のうち一種以上からなることを特徴とする。この具体的な構成により、安価で高輝度の電界発光灯を容易に提供できる。

【0014】また、本発明の電界発光灯は、裏面電極における酸化亜鉛は、アルミニウムをドーピングして半導体化された酸化亜鉛であることを特徴とする。この具体的な構成により、安価で高輝度の電界発光灯を容易に提供できる。

【0015】

【発明の実施の形態】本発明の電界発光灯の第1の実施の形態について図を参照しながら説明する。第1の実施の形態の電界発光灯10は図1の断面図に示す構造をしている。この電界発光灯10は次のようにして製造する。まず、透明フィルム1a上にITO等の透明電極1bを蒸着した透明導電フィルム1の該透明電極1b上に、硫化亜鉛を銅

で付活した蛍光体2aをバインダ用樹脂2b（例えばポリエステル系樹脂）に分散したインクを用いてスクリーン印刷し、発光層2を形成する。その上にカーボンペースト等からなる裏面電極3を印刷形成する。その上にエポキシ系樹脂、フェノール系樹脂等の絶縁保護層4を印刷形成し、電界発光灯10を得る。

【0016】本発明の電界発光灯の特徴は、図2に示すように、発光層2において蛍光体2aが絶縁性の樹脂2b中に確実に埋設されていることである。蛍光体2aは樹脂2bで被覆されるので絶縁性が高い。このため、反射絶縁層を省くことができる。発光層2の上に直接裏面電極3を形成しても絶縁耐圧が不足することはない。発明者の実験検討によると、図2に示した形態の発光層を形成するためには、発光層の樹脂に対する蛍光体の割合と発光層の膜厚との組み合わせを適正範囲にする必要がある。すなわち、発光層の樹脂に対する蛍光体の割合（重量比率）を2.5～4.5とし、膜厚を40～50 μ mとすることにより、蛍光体が樹脂中に埋設されて十分な絶縁耐圧を有し、かつ実用輝度を確保した電界発光灯を得ることができるのである。

【0017】次に、前記範囲の根拠となる実験結果について図を参照して詳しく説明する。図3は、発光層膜厚をパラメータにした場合の樹脂に対する蛍光体の割合と絶縁耐圧の関係を示す。図3から、蛍光体の割合が小さいほど、また発光層膜厚が大きくなるほど絶縁耐圧が向上することがわかる。なお、絶縁耐圧は60Hzの交流電圧を電界発光灯に印加し、絶縁破壊が生じた時の電圧値である。電界発光灯は、通常、出力電圧が40～60VのICインバータで駆動されるため、絶縁耐圧は75V以上必要である。

【0018】次に、図4は、発光層膜厚をパラメータにした場合の樹脂に対する蛍光体の割合と輝度（cd/m²）の関係を示す。図4から、膜厚が小さいほど輝度が高くなる傾向がわかる。しかし、膜厚が略40 μ mより小さくなると、蛍光体割合が増加すると輝度は急減する。実用輝度として2cd/m²以上は必要である。なお、輝度はICインバータ（サイベックス製IC 4422Aiに、150pFのコンデンサ、10mHのコイルを接続したインバータ）を用い、入力電圧3.5Vで評価した。

【0019】以上、図3、図4に示した結果を総合すると、絶縁耐圧75V以上、輝度2cd/m²以上であって絶縁耐圧と輝度のバランスがとれた電界発光灯を得るためには、樹脂に対する蛍光体の割合を2.5～4.5とし、発光層膜厚を40～50 μ mとすることが望ましい。

【0020】なお、第1の実施の形態では、発光層のバインダとしてポリエステル系樹脂を用いたが、熱硬化型のフェノール系、メラミン系、エポキシ系、ポリエステル系等の樹脂を用いれば、裏面電極形成時に裏面電極用ペーストの溶剤が発光層に侵入するのを抑制することが

できる効果がある。また、裏面電極用ペーストの溶剤に発光層の樹脂を溶解しないものを用いても効果的である。

【0021】次に、本発明の電界発光灯の第2の実施の形態について説明する。その特徴は、第1の実施の形態の電界発光灯の裏面電極の材料を改良して輝度を大幅に向上した点にある。第1の実施の形態の電界発光灯では裏面電極に黒色のカーボンペーストを用いているため、蛍光体の発光が吸収されて輝度が低くなる。また、カーボンペーストによる抵抗損失もある。第2の実施の形態の裏面電極は、カーボンペーストに代えて金属光沢のある反射率の高い金属微粉末（例えば、銀粉、アルミニウム粉、ニッケル粉等）を樹脂中に混合したペーストを用いている。導電性は金属微粉末で確保する。導電性はカーボン、酸化スズ、酸化インジウム等よりも格段に優れている。この構造により、裏面電極の抵抗値と反射率が大幅に改善され輝度を向上させることができる。

【0022】図5は、裏面電極材料をパラメータとした場合の樹脂に対する蛍光体の割合と輝度の関係である。発光層膜厚は40 μ mである。裏面電極に銀ペーストを用いることにより、反射率が向上するとともに、導電性が高く表面抵抗が小さくなるため、カーボンに比べて輝度が2倍以上向上する。銀ペーストの他にアルミニウム粉、ニッケル粉等を樹脂中に混合したペーストを用いた場合も同様の結果が得られる。

【0023】次に、本発明の電界発光灯の第3の実施の形態について説明する。第3の実施の形態は第2の実施の形態よりもさらに反射率を向上させて輝度を向上したものである。電界発光灯の構造は第1の実施の形態と同様の構成であるが、特徴は裏面電極の組成にあり、金属光沢のある反射率の高い金属粉末（例えば、銀粉、アルミニウム粉、ニッケル粉等）と白色絶縁性フィラー（例えば、酸化チタン、チタン酸バリウム、酸化亜鉛等の微粉末）を樹脂中に混合したペーストを用いて印刷形成している。この構成によりさらに反射率が改善され、輝度が向上する。図6は一例で、裏面電極の銀粉に対する酸化チタン粉の割合と輝度（ICインバータ駆動時）との関係である。図6に示すように酸化チタン粉等の白色絶縁性フィラーを銀ペーストに適量添加することにより反射率が向上し輝度が向上する。銀粉に対する酸化チタン粉の割合は20～30（重量比）が好適する。白色絶縁性フィラーを大量に添加すると裏面電極の抵抗値が増加し、抵抗損失が増えてICインバータの出力電圧がさがらず、急激に輝度が低下する。酸化チタンに代えてチタン酸バリウムや酸化亜鉛を使用しても同様の結果が得られる。

【0024】次に、本発明の電界発光灯の第4の実施の形態について説明する。第4の実施形態は第3の実施の形態よりも導電性を向上してさらに輝度を向上したものである。電界発光灯の構造は第1の実施の形態と同様の

構成であるが、特徴は裏面電極に銀粉と白色導電性フィラー（例えば、導電性を付与した酸化チタン、チタン酸バリウム、酸化亜鉛等の微粉末）を樹脂中に混合したペーストを用いている。この構造により白色フィラーが導電性を有し裏面電極の抵抗損失がさらに減るのでICインバータの効率が向上して輝度が向上する。図7は一例で、裏面電極の銀粉に対する導電性酸化チタン粉の割合と輝度（ICインバータ駆動時）との関係である。比較のために図6の絶縁性酸化チタン粉を混合した場合の結果も示す。図7に示すように導電性酸化チタン粉等の白色導電性フィラーを銀ペーストに添加することにより輝度がさらに向上する。白色フィラーが導電性であるため抵抗値が増加し難いので、第3の実施例（図6）よりも白色フィラーの割合を増加できる。図7では16～51（重量比率）の広い範囲で図6の最大輝度略7.2cd/m²より高い輝度が得られる。最大輝度は割合が略40の時に得られる。白色導電性フィラーであっても金属粉末よりは抵抗値が大きいため、大量に添加すると裏面電極の抵抗値が増加し、抵抗損失が増えてICインバータの出力電圧がさがらず、急激に輝度が低下する。

【0025】白色導電性フィラーとしては、酸化チタン、チタン酸バリウム、酸化亜鉛等の白色微粉末の表面にSnO₂、In₂O₃などの透明導電層を形成したもの、また、白色微粉末の結晶中に微量不純物をドーピングして半導体化したものなどが好適する。例えば、粒径0.03～0.3 μ mのルチル型TiO₂の表面にSbドーピングSnO₂からなる導電層を被覆したもの（石原産業（株）、ETシリーズなど）、ZnO結晶中にAl³⁺をドーピングしてn型半導体化したもの（ハクスイテック（株）、23-Kなど）が好適する。

【0026】

【発明の効果】本発明によれば、発光層の蛍光体と樹脂の比率、発光層膜厚を最適化したので、発光層の絶縁性が向上する。このため、反射絶縁層を除去できて透明電極、発光層、裏面電極の3層構造の安価な電界発光灯を提供できる。

【0027】また、光の反射率が高く、抵抗値の低い材料を用いて裏面電極を形成したので、ICインバータ駆動で輝度を向上させた3層構造の安価な電界発光灯を提供できる。

【図面の簡単な説明】

【図1】 本発明の第1の実施の形態の電界発光灯の断面図

【図2】 本発明の第1の実施の形態の電界発光灯における発光層の要部拡大断面図

【図3】 本発明の第1の実施の形態の電界発光灯において、発光層膜厚をパラメータとした場合の樹脂に対する蛍光体の割合と絶縁耐圧の関係を示す図

【図4】 本発明の第1の実施の形態の電界発光灯において、発光層膜厚をパラメータとした場合の樹脂に対す

る蛍光体の割合と輝度の関係を示す図

【図5】 本発明の第2の実施の形態の電界発光灯において、裏面電極材料をパラメータとした場合の樹脂に対する蛍光体の割合と輝度の関係を示す図

【図6】 本発明の第3の実施の形態の電界発光灯において、裏面電極の銀粉に対する酸化チタンの割合と輝度の関係を示す図

【図7】 本発明の第4の実施の形態の電界発光灯において、裏面電極の銀粉に対する導電性酸化チタンの割合と輝度の関係を示す図

【図8】 従来の電界発光灯の断面図

【符号の説明】

1 透明導電フィルム

1a 透明フィルム

1b 透明電極

2 発光層

2a 蛍光体

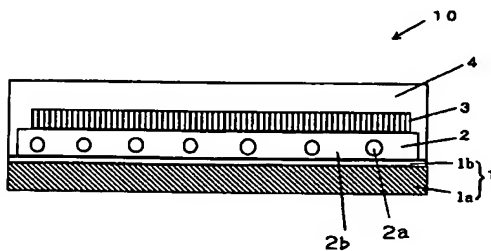
2b 樹脂 (バインダ)

3 裏面電極

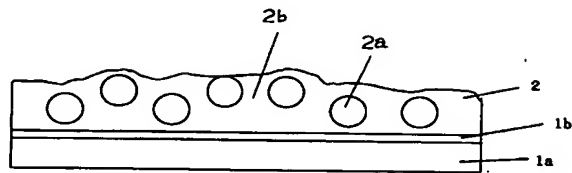
4 絶縁保護層

10 10 電界発光灯

【図1】

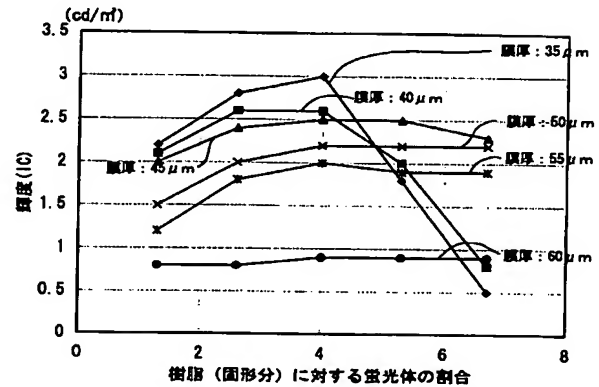
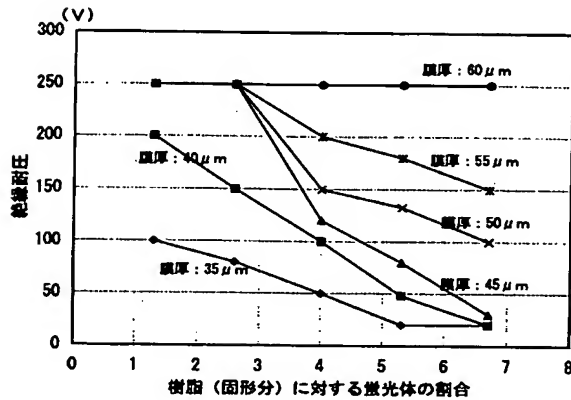


【図2】



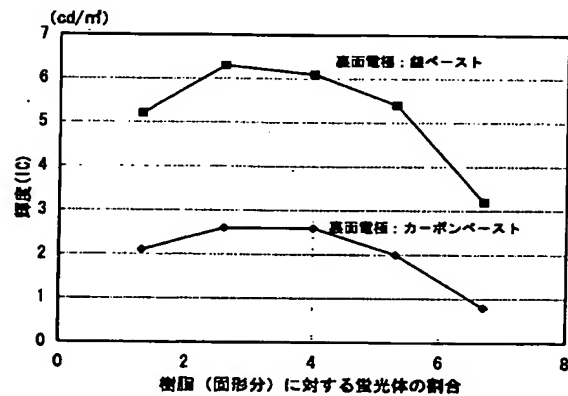
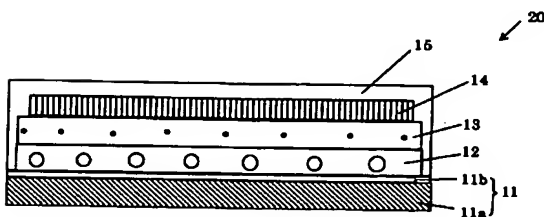
【図4】

【図3】

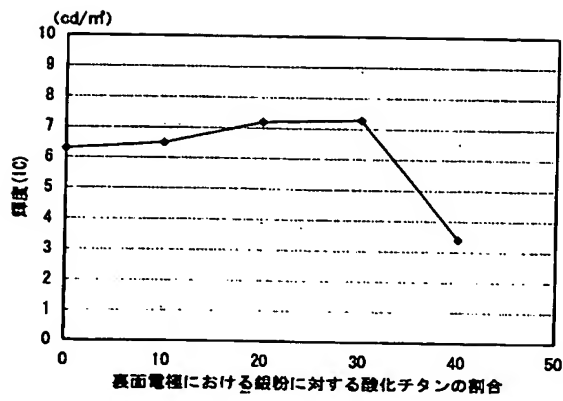


【図5】

【図8】



【図6】



【図7】

